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Transient Pulse Monitor

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Transient Pulse Monitor

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Abstract

This project involved the design of a new Transient Pulse Monitor (TPM) for the recording of key characteristics of lightning strikes and other transient pulses in the vicinity of spacecraft launch sites, to be used in a comprehensive Online Lightning Monitoring System (OLMS). This report documents the design for implementation on Signatec Digitizer boards, using an internal FPGA for processing, a 16-bit ADC to read sensor signals, and a PCI-X bus to interface with a central server. The design was completed using VHDL and Verilog and simulated. Progress was also made in debugging of the code on the physical FPGA.

Executive Summary

The project was to assist in developing the next generation of SRI International's Online Lightning Monitoring System (OLMS). OLMS is a system that utilizes electromagnetic sensors and FPGA processing to offer key data to space system launch engineers.

This particular project involved developing a next-generation Transient Pulse Monitor (TPM) which characterizes electromagnetic transient signals. (Adamo, Hammond, & Dana, 1996) As described in the patent by SRI, "Transients can occur at any time with varying amplitude, frequency, and duration." (Sechi & Adamo, 2002) Transients can affect the health and performance of system components, and therefore the monitoring of these transients is necessary if a particular system is going to be exposed to such pulses. One example of transients that a system could experience is lightning. The current and energy from a lightning strike could potentially damage grounded system components and cause malfunctions or failures.

This report looks into the system architecture for a TPM that can calculate important transient norms in real-time, with an eye towards expandability and an independence of specific board architecture. To do this the design phase takes two distinct steps. First, the report discusses a pipeline architecture in a simulation environment to show the high level design on an FPGA. Second, the report investigates a specific implementation of this architecture on a transitional third party Data Acquisition board from Signatec, and shows the results of a specific firmware implementation using a mix of third-party VHDL and custom Verilog modules. The results from these two implementations will allow SRI to develop a feasible replacement to the current OLMS system using commercial, off-the-shelf parts. The finished TPM system will be used for the Online Lightning Monitoring System (OLMS) to prevent unnecessary re-testing of grounded space systems after transients.